PART IV

SITE DIVERSITY AND SENSITIVITY TO POTENTIAL ENVIRONMENTAL DISRUPTIONS

PRESENCE, ABSENCE CHECKLISTS

From its inception in 1994, the Antarctic Site Inventory has collected data regarding the presence or absence of nesting species of penguins and flying birds, wallows of southern elephant seals, and large patches or beds of lichens and mosses at all sites visited. Inventory researchers also record whether nests, wallows, and large floral patches/beds may be readily/easily accessed and/or trampled. A master checklist of results is updated from season to season, and is presented in Appendix 6, by Antarctic Site Inventory subarea.

SPECIES DIVERSITY

These presence/absence data are used to rank sites as to their species diversity, based on cumulative tallies of breeding penguins and seabirds recorded, southern elephant seals, and large patches or beds of lichens and mosses. Sites with "high" species diversity tallied 10 or more faunal species or major floral groups. Sites with "medium" species diversity tallied 5-9 faunal species or major floral groups. "Low" diversity sites tallied 0-4 faunal species or major floral groups.

As of the close of the 2002-03 season, five sites with *high species diversity* have been identified: Hannah Point (SH), Penguin Island (SH), the Aitcho Islands (SH), Cuverville Island (NW), and Fort Point (SH).

Seventeen sites with *medium species diversity* have been identified: Arctowski Station (SH), Astrolabe Island (NW), Baily Head (SH), Brown Bluff (NE), False Head (Island) Point (NE), Half Moon Island (SH), Heroína Island (NE), Jougla Point, Mitchell Cove, Robert Island (SH), Port Lockroy (NW), Point Lookout (EI), Orne Island (NW), Paulet Island (NE), Petermann Island (SW), Pléneau Island (SW), Turret Point (SH), Whaler's Bay (SH), and Yankee Harbor (SH).

POTENTIAL SITE SENSITIVITIES

These presence/absence data also are used to rank sites as to their potential sensitivity to disruption by visitors, depending on: (a) the number of penguin and seabird species whose nests visitors may access easily, (b) whether or not visitors may access southern elephant seal wallows easily, and (c) whether or not visitors may access easily and possibly trample large patches or beds of lichens and mosses. Sites with five (5) or more tallies were considered to be "highly" sensitive to potential disturbances by visitors; sites with 3-4 tallies were considered to be "moderately" sensitive; and sites with 0-2 tallies were considered to have "low" sensitivity to potential disturbances.

Four *highly sensitive sites* have been identified: Hannah Point (SH), Penguin Island (SH), the Aitcho Islands (SH), and Turret Point (SH).

Twelve *moderately sensitive sites* have been identified: Booth Island, Port Charcot (SW), Brown Bluff (NE), Detaille Island (SW), Fort Point (SH), Gourdin Island (NW), Neko Harbor (NW), Orne Island (NW), Paulet Island (NE), Petermann Island (SW), Pléneau Island (SW), Georges Point, Rongé Island (NW), and Waterboat Point (NW).

RESTRICTED VISITOR SPACE

Following discussion in the first edition of the *Site Compendium*, Inventory researchers have begun to assess whether a site has restricted visitor space, based on: (a) whether there are only very narrow or, perhaps, non-existent pathways between visitors and nesting penguins; and (b) whether high tides or other landing conditions (e.g. ice caked on shore) crowd penguins or other wildlife onto the landing beach.

Seventeen (17) sites with *restricted visitor space* have been identified: Amphibolite Point (SO), Astrolabe Is. (NW), Brown Bluff (NE), Cuverville Island (NW), Fort Point, Greenwich Is. (SH), Gourdin Island (NW), Half Moon Island (SH), Hannah Point (SH), Heroina Island (NE), Hope Bay/Esperanza Station Vicinity (NE), Hydrurga Rocks (NW), Jougla Point, Port Lockroy (NW), Neko Harbor (NW), Paulet Island (NE), Point Lookout, Elephant Island (EI), Point Wild (EI), and Waterboat Point (NW).

ATTRACTION TO DIVERSE, SENSITIVE SITES

With respect to the 1998-99 season, Antarctic Site Inventory researchers analyzed whether zodiac landings were disproportionately "attracted" to sites exhibited high or medium species diversity, or to sites exhibiting high or moderate sensitivity to potential environmental disruptions (Naveen, et al., 2000, attached as Appendix 7).

It was found that the five sites with *high* species diversity comprised only 5.9% of the 85 sites visited that season, but attracted 18.2% of all landings and 14.3% of all visitors. The fifteen sites with *medium* species diversity comprised 17.7% of sites visited that season, but attracted 39.4% of landings and 35.5% of all visitors. That sites with high/medium species diversity accounted for more than 50% of all Peninsula zodiac landings and visitors is highly significant statistically, and supports conventional wisdom that visitors come to the Peninsula to see a diversity of wildlife.

However, because of the physical variation in landing sites, species diversity does not necessarily equate to visitors' attaining relatively close views of resident fauna and flora. Using the Inventory's presence/absence data as a base, this paper further examined whether disproportionate numbers of zodiac landings occur where visitors may attain this close proximity, relying on the sensitivity ranking of sites noted above. It was assumed that sites are more or less sensitive to potential disturbance according to the number of penguin and seabird species whose nests visitors may access easily, whether or not visitors may access southern elephant seal wallows easily, and whether or not visitors may access easily and possibly trample large patches or beds of lichens and mosses.

In the 1998-99 season, the four sites with high sensitivity to potential disturbances by visitors comprised 4.7% of sites visited that season, but attracted 11.8% of all landings and 9.6% of all visitors. The nine sites with moderate sensitivity to potential disturbances comprised 10.6% of the 85 sites visited that season, but attracted 15.4% of landings and 14.6% of all visitors. That sites with high/moderate sensitivity to potential visitor disturbances accounted for more than 24% of all Peninsula zodiac landings and visitors is also highly significant statistically, and supports the view that visitors come to see wildlife that is easily accessed.

This highly significant attraction was maintained, even when the 30 sites visited only once that season were removed from the analysis. With respect to the 55 Peninsula sites experiencing two or more zodiac visitor landings in the 1998-99 season, the 17 sites with high/medium species accounted for 59.5% of the landings and 59.7% of the visitors, and the 12 sites with high/moderate sensitivity accounted for 28.1% of the landings and 29.0% of the visitors.

POPULATION CHANGES, TRENDS

Part I of the *Site Compendium* notes that an overarching goal of the Antarctic Site Inventory is to establish baselines of site-descriptive information and biological data. Over time, it is intended that these baselines will enable environmental changes to be detected and potential causes for such changes to be examined.

Part II of the *Site Compendium* delineates much of the census data the Antarctic Site Inventory has collected since 1994; however, as emphasized in Part I, caution is appropriate when comparing Inventory-collected data to historical population data compiled in Croxall & Kirkwood (1979), Woehler (1993), and Woehler & Croxall (1996), since these compilations may reflect nest and chick counts obtained at various times, utilizing varying or inconsistent methodologies.

As a result, the focus has been identifying significant trends in data the Inventory has collected, which employs a consistent census methodology.

To date, the Inventory has identified a downward trend in blue-eyed shag populations at five sites where the project has identified nesting shags: the cliffside colonies near Almirante Brown Station, Paradise Bay (NW); Hannah Point, Livingston Island (SH); Jougla Point, Port Lockroy, Wiencke Is. (NW); Petermann Island (SW); and the Orne Islands (NW) (see Naveen, et al., 2000, attached as Appendix 7).

Shag nests in the vicinity of the Almirante Brown Station declined 50%, from 100 to 49, in the 1994-2000 period. Shag nests at the Orne Islands visitor site declined from fifteen nests in November 1994 to zero in December 1999. However, for Petermann Island and Jougla Point, the null hypothesis that the negative slopes of the log-transformed data were the result of chance alone could not be rejected. Declines at the other sites were either highly significant or significant.

The Almirante Brown and Orne Islands colonies are either inaccessible to tourists or receive few tourist visits (Naveen: 1997a, 1999). This suggests that human disturbance is an unlikely cause of such declines. In December 1999 at the Orne Islands site, which has a northwestern-to-southwestern exposure to the Gerlache Strait, one-meter-deep snow was noted on the shags' nesting ledges. At the other three sites (Petermann Island, Jougla Point, Hannah Point), the shag population now may have stabilized or slightly increased since the decline from 1994-1995 levels. Collectively, these declines, observed at different sites throughout the Peninsula, may be indicative of some underlying environmental change and suggest further monitoring.

Regarding the potential effects of visitors on penguin populations, a recent paper (Cobley & Shears, 1999) reflects on Jougla Point, Port Lockroy (NW), which is one of the regular, Antarctic Site Inventory census sites. Jougla Point lies adjacent to the recently restored hut at Goudier Island and both sites are heavily visited. In the 1999-2003 period, Jougla Point ranked second in overall numbers of zodiac landings, and Goudier Island ranked sixth (Appendix 4).

Cobley & Shears examined effects of visitor disturbance on the breeding performance of gentoo penguins during the austral summer of 1996-97 by comparing pairs in experimental areas (visited by 35-55 tourists every 1-2 days) and control colonies (not visited by tourists). They found no differences between the two groups in the proportion of birds that laid, in hatching success, or the proportion of single-chick broods, and that the overall breeding success, based on counts of crèched birds, was similar to other southern populations of gentoo penguins after correcting for mortality between crèching and fledging. Historical data from Goudier Island indicate that this colony established itself in 1985 and has rapidly increased in size since.

Regarding the Jougla Point colony, which the Inventory censuses regularly, Cobley & Shears also note a population increase, but at a slower rate. They conclude that that it is unlikely that disturbance from tourist visits has been a major determinant of gentoo population change at Port Lockroy.

Woehler (1993) reports a gentoo penguin population at Jougla Point of 1,616 N1, deriving from a 1988 census. From 1997-1999,

Antarctic Site Inventory recorded N1 gentoo penguin counts at Jougla Point ranging from 1,405-1,681; during the 2001-02 season, with heavy snow throughout the Northwest Peninsula (NW) subarea, 837 N1 was recorded; in December 2002, 1,556 N1 was recorded.

Appendix 6: SO. ORKNEY, ELEPHANT IS. subareas, site diversity, sensitivity, visitor space

			SPP. DIV	PROX	ENV SENS	ADPE	CHPE	GEPE	MCPE	SOGP	ANFU	PIPE
1	ORCA	Orcadas Stn. Vicinity	3	3	0	1	1					1
2	AMPH	Amphibolite Point	4	6	2	2	2					
3	GIBB	Gibbon Bay	3	3	0		1					
4	WILD	Point Wild	2	3	1		2		1			
5	LOOK	Pt. Lookout	6	8	2		2		1	1		

Source: ASI Data Sheets, 1994-2003

Key:
w/r penguins and flying birds;
1 = present and probably nesting, but nests not readily accessed
2 = confirmed nesting and nests easily accessed
w/r flora;
1 = present
2 = present in large beds/patches accessed, potentially may be trampled
w/r elephant seals;
2 = substantial wallow that is readily accessed

ADPE = Adélie penguin
CHPE = chinstrap penguin
GEPE = gentoo penguin
MCPE = macaroni penguin
SOGP = southern giant petrel
ANFU = Antarctic fulmar
PIPE = pintado petrel
SNPE = snow petrel
BESH = blue-eyed shag
SNSB = snowy sheathbill
WISP BBSP = Wilson's storm-petrel, black-bellied storm-petrel
KEGU = kelp gull
ANTE = Antarctic tern
E SEAL = southern elephant seal wallow
LICH = lichens, spp.
MOSS = moss, spp.
RVS = Is there restricted visitor space?

Appendix 6: SO. ORKNEY, ELEPHANT IS. subareas, site diversity, sensitivity, visitor space

	SNPE	BESH	SNSB	Skua spp.	WISP BBSP	KEGU	ANTE	E SEAL	LICH	MOSS	RVS
ORCA											
AMPH			1						1		YES
GIBB			1		1						
WILD											YES
LOOK	1		1					2			YES

Appendix 6: NORTHEAST subarea, site diversity, sensitivity, visitor space

			SPP. DIV	PROX	ENV SENS	ADPE	CHPE	GEPE	MCPE	SOGP	ANFU	PIPE
1	BALD	Bald Head	0	0	0							
2	BROW	Brown Bluff, Tabarin Pen.	8	11	3	2		2				1
3	BURD	Cape Burd	1	1	0							
4	CRYS	Crystal Hill	0	0	0							
5	DEVI	Devil Is.	4	6	2	2						
6	DURV	D'Urville Monument	2	4	2	2		2				
7	EDEN	Eden Rocks	1	2	1	2						
8	EAGL	Eagle Island	0	0	0							
9	FALS	False Head (Island) Point	5	6	1							
10	HERO	Heróina Is.	7	9	2	2		2				
11	HILL	Camp Hill	0	0	0							
12	HOPE	Hope Bay (Esperanza STN)	1	2	1	2						
13	JADE	Jade Point	0	0	0							
14	JONA	Jonassen Is.	3	4	1			2				
15	MADD	Madder Cliffs, Joinville Is.	4	4	0	1	1					
16	MARA	Marambio STN vic., Seymour Is.	0	0	0							
17	OBEL	Point Obelisk, James Ross Island	2	2	0							
18	PAUL	Paulet Is.	8	11	3	2						
19	PEPO	Penguin Pt., Seymour Is.	1	2	1	2						
20	PERS	Persson Island	2	2	0							
21	RUMC	RumCove	1	1	0							
22	SNOW	Snow Hill Island	0	0	0							
23	TAYH	Tay Head, Joinville Island	4	6	2	2						
24	VIEW	View Point	2	2	0							

Source: ASI Data Sheets, 1994-2003

Key:
w/r penguins and flying birds;
1 = present and probably nesting, but nests not readily accessed
2 = confirmed nesting and nests easily accessed
w/r flora;
1 = present
2 = present in large beds/patches accessed, potentially may be trampled
w/r elephant seals;
2 = substantial wallow that is readily accessed

ADPE = Adélie penguin
CHPE = chinstrap penguin
GEPE = gentoo penguin
MCPE = macaroni penguin
SOGP = southern giant petrel
ANFU = Antarctic fulmar
PIPE = pintado petrel
SNPE = snow petrel
BESH = blue-eyed shag
SNSB = snowy sheathbill
WISP BBSP = Wilson's storm-petrel, black-bellied storm-petrel
KEGU = kelp gull
ANTE = Antarctic tern
E SEAL = southern elephant seal wallow
LICH = lichens, spp.
MOSS = moss, spp.
RVS = Is there restricted visitor space?

Appendix 6: NORTHEAST subarea, site diversity, sensitivity, visitor space

	SNPE	BESH	SNSB	Skua spp.	WISP BBSP	KEGU	ANTE	E SEAL	LICH	MOSS	RVS
BALD											
BROW	1				1	2			1	1	YES
BURD										1	
CRYS											
DEVI				2					1	1	
DURV											
EDEN											
EAGL											
FALS	1			2	1				1	1	
HERO		1	1	1		1			1		YES
HILL											
HOPE											YES
JADE											
JONA						1			1		
MADD			1			1					
MARA											
OBEL									1	1	
PAUL	1	2	2	1	1	1			1		YES
PEPO											
PERS									1	1	
RUMC									1		
SNOW											
TAYH	1						2		1		
VIEW						1			1		

Appendix 6: SOUTH SHETLAND ISLANDS subarea, site diversity, sensitivity, visitor space

			SPP. DIV	PROX	ENV SENS	ADPE	CHPE	GEPE	MCPE	SOGP	ANFU	PIPE
1	AITC	Aitcho Is.	11	20	9		2	2		2		2
2	ARCT	Arctowski Station Vicinity	7	8	1		1	1				
3	BAIL	Baily Head, Deception Is.	5	7	2		2					1
4	FERR	Ferraz STN Vicinity, KGI	2	2	0							
5	FORT	Fort Point, Greenwich Is.	12	15	3		2	2	2		1	1
6	HALF	Half Moon Is.	8	10	2		2					
7	HANN	Hannah Point	12	21	9		2	2	2	2		1
8	JUBA	Jubany STN, KGI	2	3	1							
9	MITC	Mitchell Cove, Robert Island	5	7	2							
10	PEND	Pendulum Cove	0	0	0							
11	PENG	Penguin Is.	10	17	7	2	2			2		
12	ROBE	Robert Point	4	6	2		2					1
13	TELE	Telefon Bay, Deception Is.	0	0	0							
14	TURR	Turret Point, KGI	9	15	6	2	2			2		
15	VAPO	Vapour Col, Deception Is.	1	2	1		2					
16	WHAL	Whalers Bay, Deception Is.	5	6	1							1
17	YANK	Yankee Harbor	6	8	2			2				

Appendix 6: SOUTH SHETLAND ISLANDS subarea, site diversity, sensitivity, visitor space

	SNPE	BESH	SNSB	Skua spp.	WISP BBSP	KEGU	ANTE	E SEAL	LICH	MOSS	RVS
AITC			1	2		2	2	2	1	2	
ARCT				1	1			2	1	1	
BAIL				2					1	1	
FERR							1			1	
FORT		1	1		1	1	1		1	1	
HALF		1	1	1	1	2	1		1		YES
HANN		2	2	2	1	2		2	1		YES
JUBA						1		2			
MITC				2	1		2		1	1	
PEND											
PENG			1	2	1	2	2		1	2	
ROBE						1		2			
TELE											
TURR		1				2	2	2	1	1	
VAPO											
WHAL					1	2	1		1		
YANK			1	2	1				1	1	

Appendix 6: NORTHWEST subarea, site diversity, sensitivity, visitor space

			SPP. DIV	PROX	ENV SENS	ADPE	CHPE	GEPE	MCPE	SOGP	ANFU	PIPE
1	ALMI	Almirante Brown STN vic.	4	5	1			2				
2	ASTR	Astrolabe Is.	7	8	1		2				1	1
3	BERN	Bernardo O'Higgins STN	1	2	1			2				
4	CUVE	Cuverville Is.	10	11	1			2		1		
5	DANC	Danco Is.	1	2	1			2				
6	DORI	Dorian Bay (Damoy Pt.)	2	4	2			2				
7	FOYN	Foyn Harbor, Enterprise Is.	0	0	0							
8	RONG	Georges Pt., Rongé Is.	3	6	3		2	2				
9	GOUR	Gourdin Is.	4	8	4	2	2	2				
10	GOUV	Gouvernøren Harbor	0	0	0							
11	HYDR	Hydrurga Rocks	4	5	1		2					
12	LECO	Lecointe Is.	1	1	0							
13	MELC	Melchior Is.	0	0	0							
14	MIKK	Mikklesen Harbor	1	2	1			2				
15	NEKO	Neko Harbor	4	7	3			2				
16	ORNE	Orne Is.	7	10	3		2					
17	LOCK	Jougla Point, Port Lockroy	6	8	2			2				
18	POPT	Portal Point	0	0	0							
19	PRIE	Priest Island	1	1	0							
20	PYPT	Py Point	2	4	2			2				
21	SIFF	Siffrey Point	3	3	0							
22	SPRI	Sprightly Is. vic., (incl. Spring Pt.)	1	2	1		2					
23	WATE	Waterboat Point	3	6	3		2	2				

Appendix 6: NORTHWEST subarea, site diversity, sensitivity, visitor space

	SNPE	BESH	SNSB	Skua spp.	WISP BBSP	KEGU	ANTE	E SEAL	LICH	MOSS	RVS
ALMI		1	1				1				
ASTR		1	1		1		1				YES
BERN											
CUVE		1	1	1	1	1	1		1	1	
DANC											
DORI				2							
FOYN											
RONG			2								
GOUR				2							YES
GOUV											
HYDR		1			1	1					YES
LECO		1									
MELC											
MIKK											
NEKO				2		2				1	YES
ORNE		2	1	2	1				1	1	
LOCK		2		1		1	1		1		YES
POPT											
PRIE		1									
PYPT				2							
SIFF	1								1	1	
SPRI											
WATE			2								YES

Appendix 6: SOUTHWEST subarea, site diversity, sensitivity, visitor space

			SPP. DIV	PROX	ENV SENS	ADPE	CHPE	GEPE	MCPE	SOGP	ANFU	PIPE
1	BLAI	Blaicklock Island	2	4	2							
2	BOOT	Booth Island	4	7	3	2	2	2				
3	DETA	Detaille Island	4	7	3	2						
4	FISH	Fish Is.	2	4	2	2						
5	MCAL	McCall Point	1	1	0							
6	PETE	Petermann Is.	7	11	4	2		2				
7	PLEN	Pleneau Is.	8	11	3			2				
8	POUR	Pourquoi-pas Is.	4	5	1	2						
9	PROS	Prospect Point	0	0	0							
10	SHUM	Shumskiy Cove	0	0	0							
11	STON	Stonington Island	2	2	0							
12	VERN	Vernadsky Station	0	0	0							
13	YALO	Yalour Is.	3	4	1	2						

Appendix 6: SOUTHWEST subarea, site diversity, sensitivity, visitor space

	SNPE	BESH	SNSB	Skua spp.	WISP BBSP	KEGU	ANTE	E SEAL	LICH	MOSS	RVS
BLAI				2						2	
BOOT						1					
DETA		1		2		2					
FISH		2									YES
MCAL									1		
PETE		2	1	2	1				1		
PLEN		1		2		1	1	2	1	1	
POUR				1					1	1	
PROS											
SHUM											
STON				1			1				
VERN											
YALO									1	1	

Polar Record 36 (199): 323–334 (2000). Printed in the United Kingdom.

Censuses of penguin, blue-eyed shag, and southern giant petrel populations in the Antarctic Peninsula region, 1994–2000

Ron Naveen
Oceanites Inc, PO Box 15259, Chevy Chase, MD 20825, USA
Steven C. Forrest
9443 Cottonwood Road, Bozeman, MT 59718, USA
Rosemary G. Dagit
PO Box 1454, Topanga, CA 90290, USA
Louise K. Blight
Centre for Wildlife Ecology, Department of Biological Sciences, Simon Fraser University, Burnaby, BC V5A 1S6, Canada
Wayne Z. Trivelpiece and Susan G. Trivelpiece
Southwest Fisheries Center, National Marine Fisheries Service, PO Box 271, La Jolla, CA 92038, USA

Received February 2000

ABSTRACT. This paper presents new census data and population estimates for penguins, blue-eyed shags, and southern giant petrels from 26 sites in the Antarctic Peninsula, collected by the Antarctic Site Inventory from 1994 to 2000. For nine sites, population data or estimates are published for the first time. The newly discovered gentoo penguin population of 215 nests at Heroína Island (63°24'S, 54°36'W) represents the easternmost location where this species has been found breeding in the Peninsula. All three pygoscelid penguins — gentoo, Adélie, and chinstrap — were found breeding at Gourdin Island (63°12'S, 57°18'W), the fourth known site where these species nest contiguously in the Peninsula. During the period, significant declines in nesting populations of blue-eyed shag were documented at three northwestern Peninsula locations.

Contents

The Antarctic Site Inventory

From January 1994 to February 2000, under the aegis of the Antarctic Site Inventory project, 287 survey visits were made to 59 locations in the Antarctic Peninsula. A major objective of the Inventory is compiling baseline data and information that may be necessary to detect possible changes in the physical and biological variables monitored and to determine how best to minimize or avoid possible environmental impacts of tourism and non-governmental activities in the Antarctic Peninsula area.

Site visits are achieved by placing Antarctic Site Inventory researchers aboard tour ships at key census times each austral spring and summer, coinciding with the peak of penguin egg-laying (for nest censuses) and the peak of penguin chick crèching (for chick censuses). Site visits and aerial photo documentation also are undertaken in cooperation with the Royal Navy ice patrol vessel HMS *Endurance* (Naveen 1996, 1997a). Data are collected in accordance with the *CEMP standard methods for monitoring studies* (Scientific Committee for the Conservation of Antarctic Marine Living Resources 1997).

The Inventory divides the Antarctic Peninsula into six sub-areas (Fig. 1), the designations of which are:

- South Orkneys (SO), including Laurie, Coronation, and Signy islands;
- Elephant Island and nearby islands (EI);
- South Shetland Islands (SH), including Deception, Low, and Smith islands (Fig. 2);
- Northeast Antarctic Peninsula (NE), from Cape Dubouzet (63°16'S, 64°00'W) and Joinville Island (63°15'S, 55°45'W) to James Ross Island (64°10'S, 57°45'W) (Fig. 3);
- Northwest Antarctic Peninsula (NW), from Cape Dubouzet to the northern end of the Lemaire Channel (65°04'S, 63°57'W) (Fig. 4); and
- Southwest Antarctic Peninsula (SW), from the northern end of the Lemaire Channel to the northern part of Marguerite Bay (68°18'S, 67°11'W) (Fig. 5).

This paper presents new census data and population estimates for penguins, blue-eyed shags, and southern giant petrels from 26 sites in the Antarctic Peninsula, collected from 1994 to 2000. Site locations are noted in Figures 2–5.

Census data

The nest and chick census data listed in Tables 1–6 represent either site-wide censuses and estimates, or censuses and estimates of major colonies at particular sites. The data are formatted according to census codes

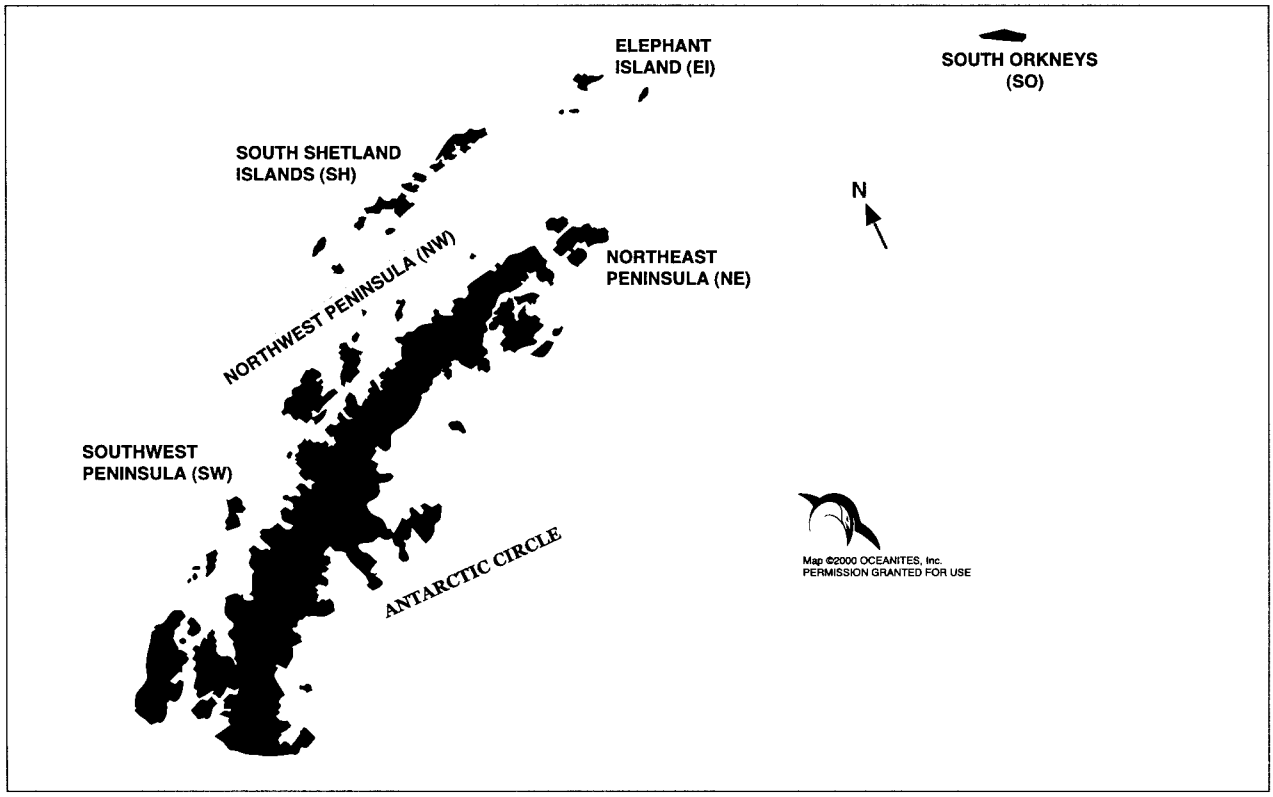

Fig. 1. Map of the Antarctic Peninsula region, indicating the six sub-areas and their abbreviations, as divided by the Antarctic Site Inventory: the South Orkneys, Elephant Island and nearby islands, the South Shetland Islands, the Northeast Antarctic Peninsula, the Northwest Antarctic Peninsula, and the Southwest Antarctic Peninsula.

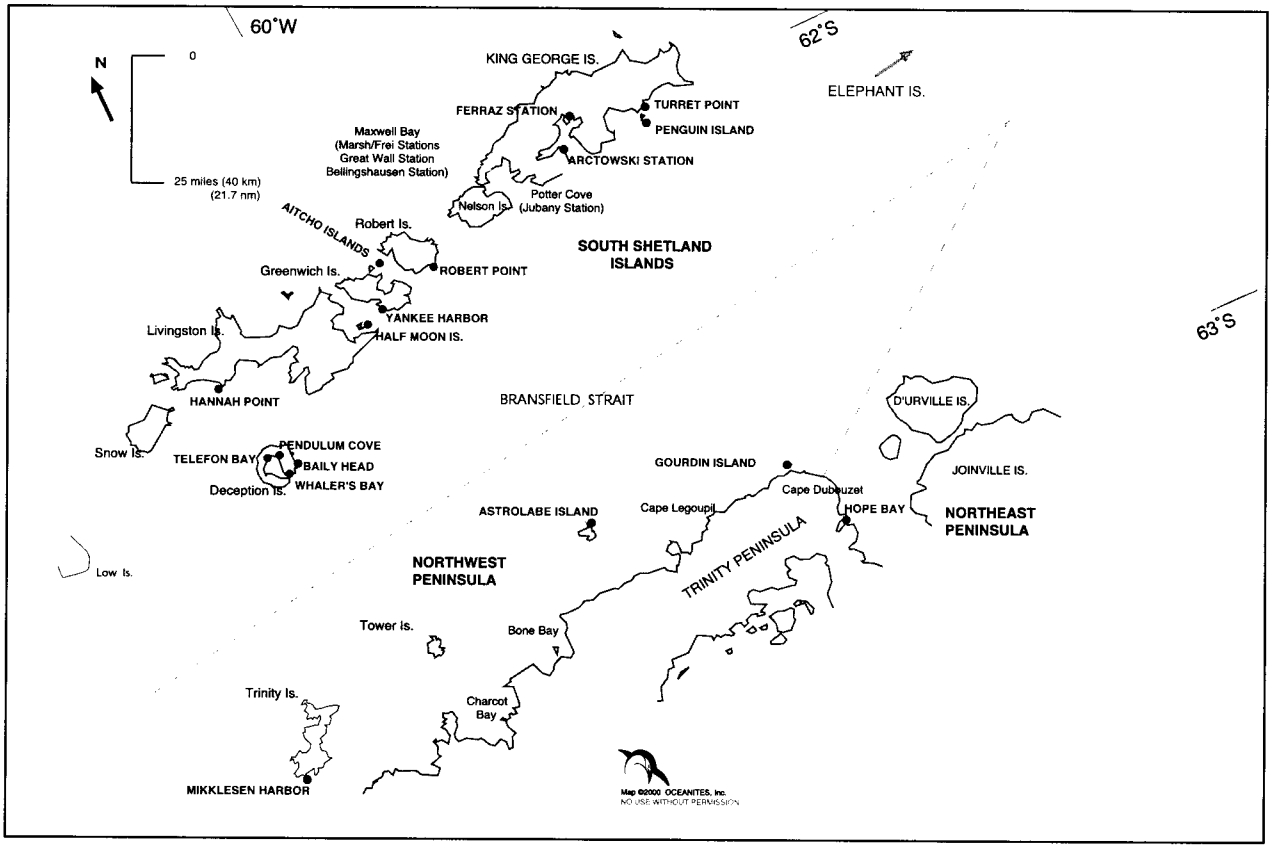

Fig. 2. Map of the South Shetland Islands and parts of the Northwest Antarctic Peninsula region.

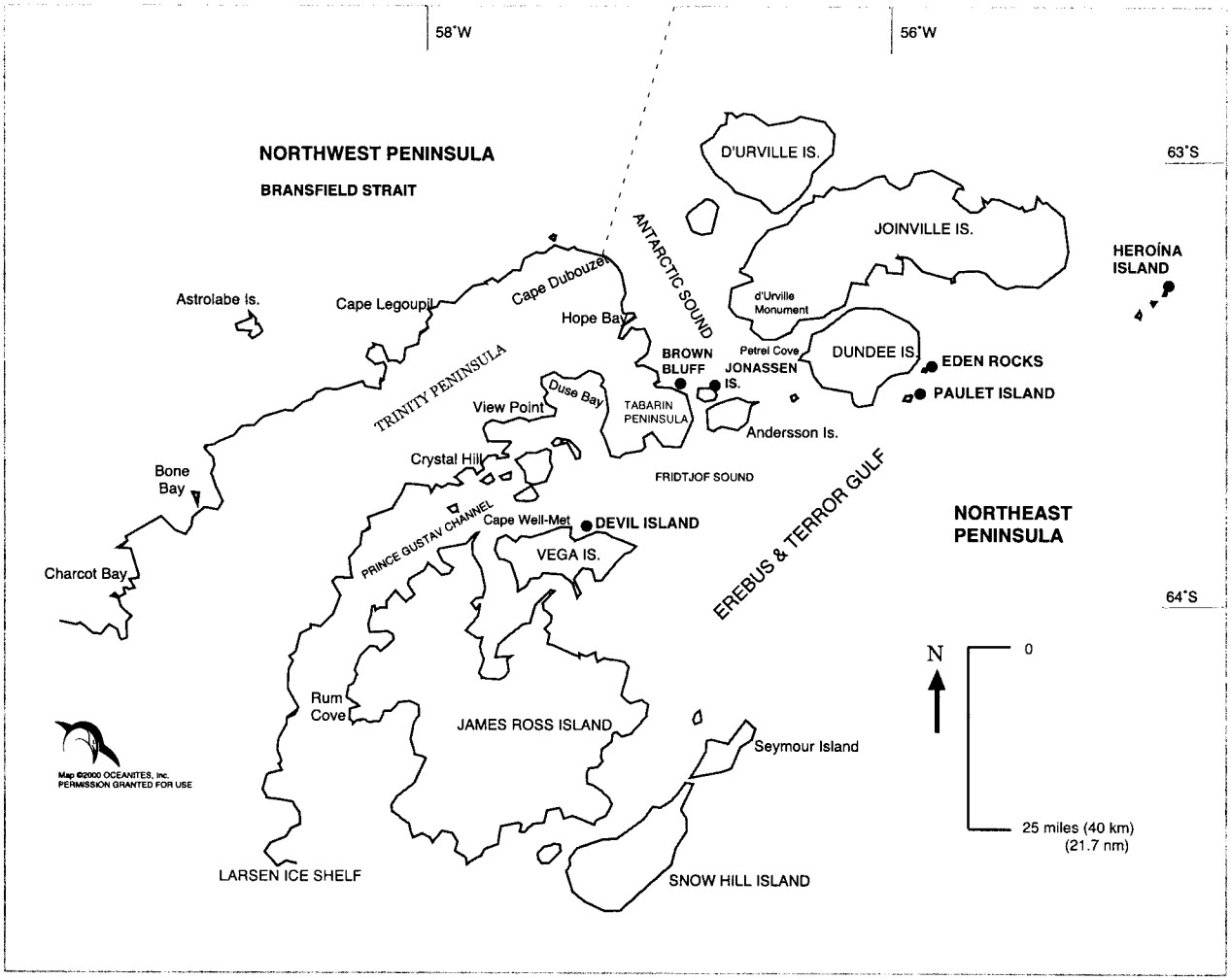

Fig. 3. Map emphasizing the Northeast Antarctic Peninsula region, as defined by the Antarctic Site Inventory.

established in Woehler (1993), which specify the nature and accuracy of each census. For example, an 'N1' census of breeding pairs/nests is the most accurate of nest counts, with pairs/nests individually counted and probably accurate to better than ±5%; a 'C1' census of chicks is the most accurate of chick counts, with chicks individually counted and probably accurate to better than ±5%. Note that chick counts are difficult to interpret, because the census may not have occurred during the peak of chick crèching or because there is variation in annual breeding productivity (crèched chicks per active nest) (Woehler 1993; Scientific Committee for the Conservation of Antarctic Marine Living Resources 1997). N1 and C1 data obtained for the Inventory represent mean values for the months in which the censuses were made.

In attempting to establish baselines at the various locations, the Inventory routinely references the historic penguin nest and chick censuses compiled in Woehler (1993) and updated in Woehler and Croxall (1996). The SCAR Sub-committee on Bird Biology is producing a revision to this data compilation, and the Inventory data presented below have been submitted for incorporation therein.

The historic data yield valuable information about penguin distribution and often reflect more detailed work being done at particular locations, but there is potential difficulty in using these data to assess population trends. These data have been collected over time by a large number of field workers using a variety of methods. As noted, the Inventory follows the *CEMP standard methods*, which requires penguin nest counts during the peak of egg-laying each season and chick censuses during the subsequent peak of chick crèching. Thus, the historic censuses may not be comparable to Inventory data because they were accomplished at various times, in varying fashions, and not necessarily in accordance with the *CEMP standard methods*. The only filter consistently applied to these compiled data relates to the exactitude of the counts themselves (that is, whether they represent actual nest counts or estimates with varying degrees of accuracy). Regarding some of the historic censuses, only the year is listed for a particular nest or chick count. In other instances, it is unclear at which point the census occurred within a particular breeding season. In other cases, where specific dates are ascribed to penguin nest or chick censuses (or where dates may be gleaned from primary source material),

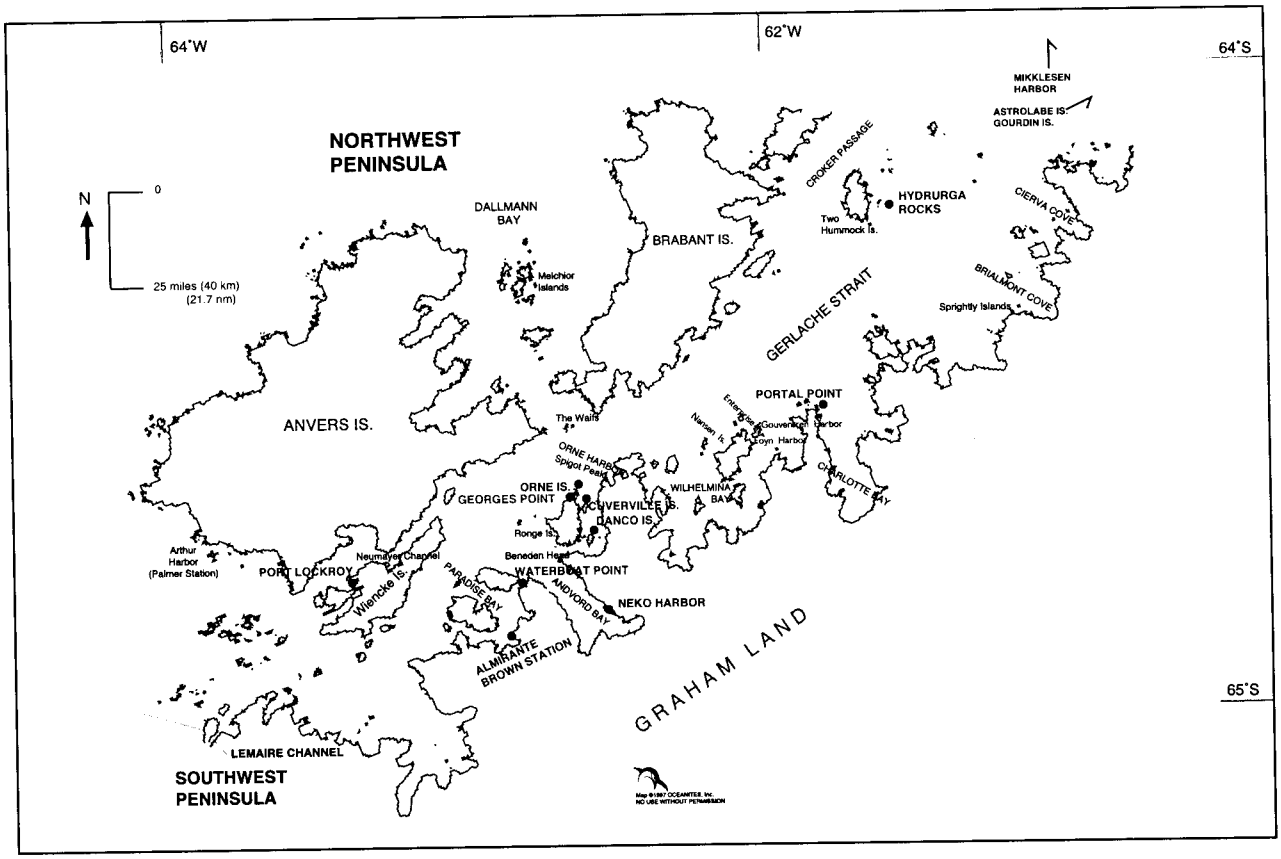

Fig. 4. Map of the Northwest Antarctic Peninsula region, as defined by the Antarctic Site Inventory.

it is unclear how close the censuses were to the peak of either egg-laying or chick crèching in that particular breeding season. See Norman (2000) for a related discussion regarding the difficulties in using historic census data.

Therefore, in the 'Discussion,' the only trends noted are those suggested by comparable data the Inventory has collected. Further, six seasons of Inventory data, in and of themselves, may be insufficient to assess long-term trends and whether any detected changes may be naturally occurring, produced perhaps by human activities, or resulting from other direct, consequential, synergistic, and cumulative effects (Naveen 1997a). With respect to future censusing efforts in the Antarctic Peninsula, whether by the Inventory or other projects, reliance on the *CEMP standard methods* will ensure that all data are fully comparable and, presumably, will enable a greater confidence in assessing and describing trends or variability. At present, in the Peninsula, long-term penguin and seabird projects on the western shore of Admiralty Bay (Site of Special Scientific Interest 8), Arthur Harbor, and Cape Shireff, Livingston Island, fully incorporate these standard, uniform procedures.

Census strategies

Regarding penguins, differences in breeding biology led to the adoption of different Inventory census strategies (Trivelpiece 1991; Williams 1995; Emslie 1997; Naveen 1997b). Chinstrap and Adélie penguins are highly faithful to specific nest sites, and do not tend to abandon regular nest sites and rookeries if there is a breeding failure in a single season. Because of the strong site fidelity of chinstrap and Adélie penguins, nest and chick censuses of discrete colonies and subgroups at a particular site may have long-term relevance, even if all colonies and subgroups at that site cannot be censused. Gentoo penguins do not exhibit the same nest-site fidelity and regularly change nesting locations if there are disturbances. This means that gentoo penguin nest and chick censuses may have long-term relevance only if all gentoo colonies and subgroups at a particular site are censused (Trivelpiece and Trivelpiece 1990; Trivelpiece and others 1990).

Discussion

Tables 1–6 list 45 censuses or population estimates of penguin, blue-eyed shag, and southern giant petrel colonies at 26 sites in the Antarctic Peninsula, collected by the Antarctic Site Inventory from 1994 to 2000. For nine sites, population data or estimates are published for the first time. The following species-specific discussion indicates sites where the Inventory has upgraded the accuracy of historic censuses. For each site, nest and chick census data are presented with the terminology suggested in Woehler (1993).

Adélie penguin

In six field seasons from 1994 to 2000, the Inventory censused or estimated populations at 14 different Adélie penguin breeding sites (Table 1). Data/estimates for seven Adélie penguin colonies in the northeast Peninsula region

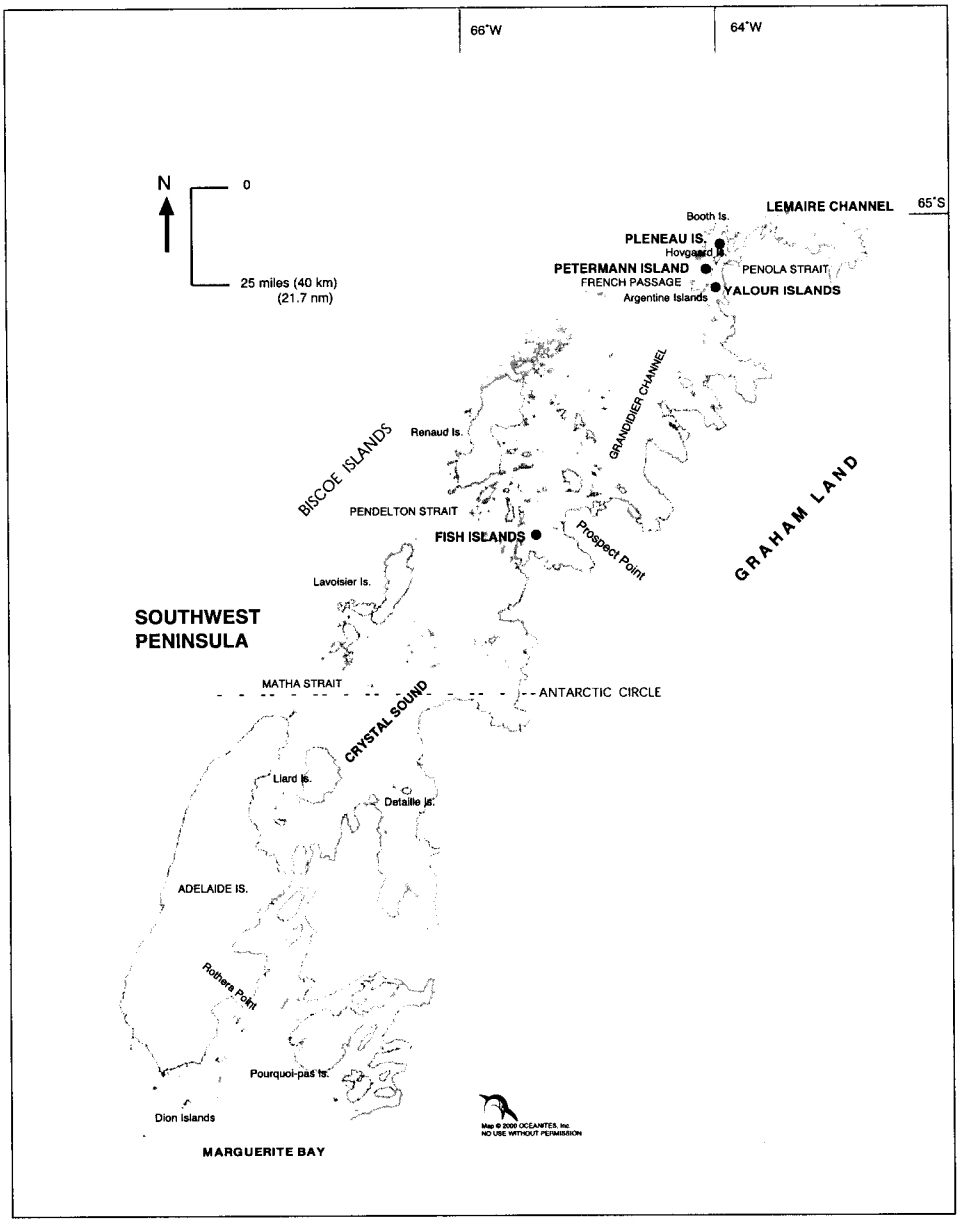

Fig. 5. Map of the Southwest Antarctic Peninsula region, as defined by the Antarctic Site Inventory.

are presented for the first time — Heroína Island, Beagle Island, Darwin Island, Platter Island, Comb Island, Eden Rocks, and Brown Bluff. The Inventory's first nest censuses/estimates at Heroína Island and Eden Rocks add a minimum of 329,364 nests to the known breeding population of Adélie penguins in the Antarctic Peninsula. With respect to historic data compiled in Woehler (1993) and Woehler and Croxall (1996), the Inventory upgraded censuses at four Adélie penguin sites to N1/2 or C1/2 counts — Jonassen Island (NE), Paulet Island (NE), Devil Island (NE), and Gourdin Island (NW). The estimate of 95,000–105,000 breeding pairs at Paulet Island (NE) does not necessarily indicate a population increase. Using a different technique, an estimate was made of 75,000 nests that are relatively contiguous to the historic Nordenskjöld expedition hut on the northwestern tip of the island, compared to an estimate of 60,000 from 1984. Further, 20,000–30,000 nests were estimated in Paulet Island's northeastern and eastern canyons, which are physically separated from the other, on-site Adélie penguins. It is not clear whether or not these canyons were censused/estimated in 1984.

Gentoo penguin

During six field seasons between 1994 and 2000, the Inventory censused or estimated breeding populations at 13 different sites of gentoo penguins (Table 2). Data for three gentoo penguin colonies are presented for the first time — Heroína Island (NE), Brown Bluff (NE), and Fort Point (SH) — and add a minimum of 1064 nests to the known breeding population of gentoos in the Antarctic Peninsula. With respect to historic data compiled in Woehler (1993) and Woehler and Croxall (1996), the Inventory upgraded censuses at four gentoo sites to N1/2 or C1/2 counts — Yankee Harbor (SH), Aitcho Islands (SH), Jonassen Island (NE), and Gourdin Island (NW). The newly discovered Heroína Island population represents the easternmost location where gentoo penguins have been found breeding in the Peninsula.

Chinstrap penguin

In six field seasons from 1994 to 2000, the Inventory censused or estimated breeding populations at seven different chinstrap penguin sites (Table 3). With respect to historic data compiled in Woehler (1993) and Woehler and Croxall (1996), the Inventory upgraded censuses at five chinstrap penguin sites to N1/2 or C1/2 counts — Aitcho Islands (SH), Hannah Point (SH), Hydrurga Rocks (SH), Fort Point (SH), and Gourdin Island (NW).

Macaroni penguin

The census at Fort Point, Greenwich Island (SH), adds a macaroni penguin nesting site not previously reported (Table 4).

Table 1. Antarctic Site Inventory censuses for Adélie penguin (*Pygoscelis adeliae*), 1994–2000. N1 = nests individually counted, accurate to better than ±5%; N2 = nests counted in known area then extrapolated over total colony area, accurate up to 5–10%; N3 = accurate estimate, accurate to 10–15%; N4 = rough estimate, accurate to 25–50%; C1 = chicks individually counted, accurate to better than ±5%; C2 = chicks counted in known area then extrapolated over total area, accurate to 5–10%; C3 = accurate estimate, accurate to 10–15%; A3 = estimates based on counts of total birds or adults individually counted, accurate to 10–15%; EL = extra large, >100,000 breeding pairs; VL = very large, 20,000–99,999 breeding pairs; L = large, 7500–19,999 breeding pairs; M = medium, 1000–7499 breeding pairs; S = small, 100–999 breeding pairs.

Census		Date	Notes
Penguin Island (SH) – 62°06'S, 57°54'W			
1966	N1	Nov 1996	Recent historic census reported in Woehler (1993) = 3114 (N1/3, 1980)
2441	N1	Dec 1997	
Turret Point, King George Island (SH) – 62°05'S, 57°55'W			
1077	N1	Nov 1997	Recent historic census reported in Woehler (1993) = 1918 (N1, 1980)
Heroína Island, Danger Islands group (NE) – 63°24'S, 54°36'W			
285,115–305,165	N2	Dec 1996	This is the first-reported Adélie penguin census for this site; Woehler (1993) notes ≥5 Adélie colonies at Danger Island group, referring to a 1978 survey that did not estimate the Heroína Island population
Beagle Island, Danger Islands group (NE) – 63°25'S, 54°40'W			
VL to EL	N4	Jan 1999	Estimate from aerial photo documentation
Darwin Island, Danger Islands group (NE) – 63°26'S, 54°46'W			
VL to EL	N4	Jan 1999	Estimate from aerial photo documentation
Platter (Plato) Island, Danger Islands group (NE) – 63°26'S, 54°40'W			
L	N4	Jan 1999	Estimate from aerial photo documentation
Comb (Peine) Island, Danger Islands group (NE) – 63°24'S, 54°42'W			
S to M	N4	Jan 1999	Estimate from aerial photo documentation
Eden Rocks (NE) – 63°29'S, 55°40'W			
Western colony			
19,649–20,785	N3	Dec 1996	Western colony only; there are large Adélie colonies on each of the two rocks comprising this site
Eastern colony			
24,600–28,905	N3	Dec 1996	Eastern colony only; there are large Adélie colonies on each of the two rocks comprising this site
Overall			
44,249–49,460	N3	Dec 1996	Total of western and eastern colonies
Brown Bluff, Tabarin Peninsula (NE) – 63°32'S, 56°55'W			
20,000	C3	Jan 1995	
Jonassen Island (NE) – 66°33'S, 56°40'W			
0	C1	Jan 1996	Woehler (1993) lists a 1901 reference to a 'large colony,' which the Inventory did not relocate
Paulet Island (NE) – 63°35'S, 55°27'W			
Northern colony, contiguous to the historic Nordenskjöld expedition hut			
75,000	N2	Jan 1999	An extrapolation from Inventory aerial photo documentation of nests contiguous to the historic Nordenskjöld expedition hut on the northwestern part of the island; recent historic nest censuses reported in Woehler (1993) = 100,000 (A3, 1981) and 60,000 (A3, Nov 1984), the latter apparently referring to nests that are relatively contiguous to the Nordenskjöld expedition hut
Northeastern/eastern canyons			
20,000–30,000	N3	Jan 1999	An extrapolation from Inventory aerial photo documentation of Adélies in the northeastern/eastern canyons, which are physically separated from the colonies contiguous to the Nordenskjöld expedition hut
Overall			
95,000–105,000	N2/3	Jan 1999	Revised estimate for entire island, based on an extrapolation from Inventory aerial photo documentation
Devil Island (NE) – 63°48'S, 57°17'W			
10,320	C2	Jan 1996	Woehler (1993) lists a 1945 reference to a 'large colony' at this site
8501	C1	Jan 2000	

Table 1 continued

Census	Date	Notes
Gourdin Island (NW) – 63°12'S, 57°18'W Northwestern colony		
14,334	N2	Dec 1997	Northwestern end of the island; more nests may be present; Woehler (1993) lists a reference to an Adélie population of 300 nests (N4, 1969)
Petermann Island (SW) – 65°10'S, 64°10'W		
862	N1	Nov 1997	Recent historic censuses reported in Croxall and Kirkwood (1979) and Woehler (1993) = 1540 (N1, Dec 1971) and 1080 (N3, 1988)
1135	C1	Jan 1999	

Table 2. Antarctic Site Inventory censuses for gentoo penguin (*Pygoscelis papua*), 1994–2000. N1 = nests individually counted, accurate to better than ±5%; N2 = nests counted in known area then extrapolated over total colony area, accurate up to 5–10%; N3 = accurate estimate, accurate to 10–15%; N4 = rough estimate, accurate to 25–50%; C1 = chicks individually counted, accurate to better than ±5%.

Census	Date	Notes
Yankee Harbor, Greenwich Island (SH) – 62°32'S, 59°47'W		
4751 N1	Nov 1999	Recent historic census reported in Woehler (1993) = 4000 (N3/4, 1990)
Aitcho Islands visitor site (SH) – 62°24'S, 59°44'W Southern and southeastern end of the island		
1177 N1	Dec 1999	Recent historic census reported in Woehler (1993) = 314 (N3, Jan 1966)
Fort Point, Greenwich Island (SH) – 62°34'S, 59°34'W		
282 N1	Dec 1999	The Inventory census in Dec 1999 totalled 1136 nests of penguin species. Woehler (1993) notes a historic census ascribed fully to chinstrap penguins (1200 nests, N4, 1987)
Hannah Point, Livingston Island (SH) – 62°39'S, 60°37'W		
1123 N1	Dec 1996	Recent historic census reported in Woehler (1993) = 1016 (N1, 1987)
1350 N1	Dec 1997	
Heroína Island, Danger Islands group (NE) – 63°24'S, 54°36'W		
215 N1	Dec 1996	This colony has not been reported previously, and appears to be the easternmost breeding location for gentoos in the Antarctic Peninsula
Brown Bluff, Tabarin Peninsula (NE) – 63°32'S, 56°55'W		
617 N1	Nov 1999	
567 N1	Dec 1999	
Jonassen Island (NE) – 66°33'S, 56°40'W		
233 C1	Jan 1996	Woehler (1993) refers to a 1901 census of 20 nests (N4, 1901)
Gourdin Island (NW) – 63°12'S, 57°18'W Northwestern colony		
568 N2	Dec 1997	Northwest end of the island; more gentoo nests may be present. Woehler (1993) lists a reference to a gentoo population of 50 nests (N3, 1969)
Danco Island (NW) – 64°44'S, 62°37'W		
2300 N2	Nov 1999	Recent historic censuses reported in Woehler (1993) and Woehler and Croxall (1996) = 800 (C1, 1986) and 1637 (N2, 1994)
Jougla Point/Port Lockroy, Wiencke Island (NW) – 64°49'S, 63°30'W		
1595 N1	Nov 1996	Recent historic census reported in Woehler (1993) = 1616 (N1, 1988)
1405 N1	Nov 1997	
1545 N1	Dec 1997	
1437 N1	Nov 1998	
1681 N1	Nov 1999	
1501 N1	Dec 1999	
Neko Harbor (NW) – 64°50'S, 62°33'W		
934 C1	Feb 1996	Recent historic censuses = 214 (N3, 1971; reported in Croxall and Kirkwood 1979); 250 (C1, 1987; reported in Woehler 1993)
625 C1	Jan 1999	
844 N1	Dec 1999	
Pléneau Island (SW) – 65°06'S, 64°04'W		
1577 N1	Nov 1999	Recent historic census reported in Woehler (1993) = 500 (N1, 1982)
Petermann Island (SW) – 65°10'S, 64°10'W		
1224 N1	Dec 1997	Recent historic census reported in Woehler (1993) = 755 (N2, 1988)

Table 3. Antarctic Site Inventory censuses for chinstrap penguin (*Pygoscelis antarctica*), 1994–2000. N1 = nests individually counted, accurate to better than ±5%; N2 = nests counted in known area then extrapolated over total colony area, accurate up to 5–10%; N3 = accurate estimate, accurate to 10–15%; N4 = rough estimate, accurate to 25–50%; C1 = chicks individually counted, accurate to better than ±5%.

Census		Date	Notes
Aitcho Islands visitor site (SH) – 62°24'S, 59°44'W			
Southern and southeastern end of the island			
4608	N2	Nov 1997	Not including chinstrap penguins nesting on site's northern, rocky coast; Inventory censuses occur at the regular zodiac landing site in Aitchos, which is an island located northwest of Cecilia Island, that is officially unnamed on US and British Admiralty nautical charts; Woehler (1993) notes a nesting population of 3500-4000 chinstraps (N4, January 1966) for Cecilia Island, a census originally reported in Croxall and Kirkwood (1979), which, based on site maps in Croxall and Kirkwood (1979), should have been ascribed to this visitor site
Fort Point, Greenwich Island (SH) – 62°34'S, 59°34'W			
853	N1	Dec 1999	Recent historic census reported in Woehler (1993) = 1200 (N4, 1987); the Inventory census in December 1999 totalled 1136 nests of three penguin species
Hannah Point, Livingston Island (SH) – 62°39'S, 60°37'W			
1158	N1	Dec 1996	Recent historic census reported in Woehler (1993) = 1500 (N3, 1987)
1137	N1	Dec 1997	
1061	N1	Dec 1999	
1341	C1	Jan 2000	
Gourdin Island (NW) – 63°12'S, 57°18'W			
Northwestern and eastern colonies			
3282	N2	Dec 1997	Northwestern and eastern ends of the island only; more nesting chinstraps may be present; Woehler (1993) lists a 1969 reference to a 'large colony' of chinstraps. Other Peninsula sites where all three pygoscelid penguins nest contiguously have been designated as Sites of Special Scientific Interest under the Antarctic Treaty: Stranger Point, King George Island; Point Thomas, western shore of Admiralty Bay, King George Island; and Ardley Island
Hydrurga Rocks (NW) – 64°08'S, 61°37'W			
526		Nov 1996	Recent historic nest census reported in Woehler (1993) = 1000 (N4/5, 1986)
Georges Point, Rongé Island (NW) – 64°40'S, 62°39'W			
383	N1	Dec 1996	Recent historic nest censuses reported in Woehler (1993) and Woehler and Croxall (1996) = 300 (N3/4, 1984), 600 (N3, 1988), and 414 (N2, 1994)
327	N1	Nov 1998	
Orne Islands (NW) – 64°39'S, 62°40'W			
342	N1	Dec 1996	Recent historic nest censuses reported in Woehler (1993) and Woehler and Croxall (1996) = 860 (N3, 1987) and 420 (N2, 1994)
370	N1	Nov 1998	
361	N1	Dec 1998	
421	N1	Nov 1999	
332	N1	Dec 1999	
484	C1	Jan 2000	

Blue-eyed shag

Nest counts were obtained sufficient to establish a trend in blue-eyed shag nesting populations at five of 13 sites where the Antarctic Site Inventory has identified nesting shags: the cliffside colonies near Almirante Brown Station, Paradise Bay (NW); Hannah Point, Livingston Island (SH); Jougla Point, Port Lockroy, Wiencke Island (NW); Petermann Island (SW); and the Orne Islands (NW) (Table 5). An analysis of these data for the period January 1994 to January 2000 indicates declines at all of these sites. However, it was not possible to reject the null hypothesis that the negative slopes of the log-transformed data were the result of chance alone for Petermann Island and Jougla Point (Colton 1974: table 5). Declines at the other sites were either highly significant (Almirante Brown, $P < .001$, $r = .9786$, 5 df; Orne Islands, $P < .001$, $r = .9765$, 4 df) or significant (Hannah Point, $P < .05$, $r = .7422$, 6 df). Collectively, nest counts at the Almirante Brown shag colony declined 51%, from 100 to 49, in the 1994–2000 period. Nest counts at the Orne Islands colony went from

Table 4. Antarctic Site Inventory censuses for macaroni penguin (*Eudyptes chrysolophus*), 1994–2000. N1 = nests individually counted, accurate to better than ±5%; N4 = rough estimate, accurate to 25–50%; C1 = chicks individually counted, accurate to better than ±5%.

Census		Date	Notes
Hannah Point, Livingston Island (SH) – 62°39'S, 60°37'W			
8	N1	Nov 1995	Macaronis nested in three of the chinstrap penguin colonies surveyed by the Inventory; recent historic nest census reported in Woehler (1993) = 8 (N1, 1987)
6	N1	Dec 1995	
6	N1	Dec 1996	
6	N1	Dec 1997	
5	N1	Dec 1999	
3	C1	Jan 1995	
4	C1	Jan 1996	
3	C1	Jan 2000	
Fort Point, Greenwich Island (SH) – 62°34'S, 59°34'W			
1	N1	Dec 1999	The Inventory census in December 1999 totalled 1136 nests of three penguin species; Woehler (1993) notes a historic census ascribed fully to chinstrap penguins (1200 nests, N4, 1987)

15 nests in November 1994 to zero in December 1999.

The Almirante Brown and Orne Islands colonies are either inaccessible to tourists or receive few tourist visits (Naveen 1997a), suggesting that human disturbance is an unlikely cause of the decline at these sites. In December 1999 at the Orne Islands site, one-meter-deep snow on the shags' nesting ledges was noted. At the other three sites (Petermann Island, Jougla Point, Hannah Point), the shag population now may have stabilized or slightly increased since the decline from 1994–1995 levels.

Collectively, the declines observed through seven seasons at different sites throughout the Peninsula suggest that blue-eyed shag numbers should be further monitored. These declines may be indicative of some underlying environmental change affecting shag nest success.

Southern giant petrel

The Inventory has begun annual, site-wide censuses of southern giant petrel at three sites in the South Shetland Islands — Aitcho Islands, Penguin Island, and Hannah Point, Livingston Island, which are reported here for the first time (Table 6). All three have assemblages of petrels that may be easily accessed by visiting tourists. While it is too early to suggest any population trends, there is considerable concern regarding potential disturbances to this species, which has an extremely lengthy breeding cycle: a single egg is laid in early November, the incubation period lasts for approximately 60 days (until January), and each season's cohort of chicks — if they survive — will not fledge until 100–130 days after hatching, in March and later (Naveen 1997a, 1997b). Extreme care is necessary because nesting southern giant petrels are easily pushed off their eggs during the nesting season, and eggs may be easily predated by skuas. Once an egg is lost, southern giant petrels are unable to relay and breed successfully that season (Emslie 1996).

Conclusion

Data collected during the first six seasons of Antarctic Site Inventory fieldwork suggest approaches and refinements for all assessment and monitoring initiatives in the Antarctic Peninsula. The most critical of these relates to the comparability of census data, enabling trends to be assessed and described more confidently. As noted, the Inventory attempts to collect data according to the *CEMP standard methods*, a standard methodology followed by other long-term research projects in the Peninsula. If, for example, the Inventory detects a population change at a particular site, comparable data from other nearby sites will enable a determination whether the detected change is a site-specific aberration or an area-wide trend.

The *CEMP standard methods* also mandate that nest censuses be achieved as near as possible to the peak of egg-laying, and chick censuses as near as possible to the peak of chick crèching. Ensuring that data are collected during these mandated periods will enable determinations of breeding success/productivity, annual survival, and recruitment. Further, accurate breeding chronologies at key tourism sites will enable comparisons to the visitation chronology of tourists, perhaps to determine how the timing of visits relates to times within each breeding cycle when eggs or chicks are most vulnerable to disturbance.

The population decline detected at a number of blue-eyed shag breeding sites needs continued attention and investigation. The sites exhibiting highly significant declines are either inaccessible to tourists or receive few tourist visits, which potentially implicates other, natural factors like a changing climate or prey availability/distribution. It is hoped that southern giant petrel censuses initiated at three Peninsula locations will assist future determinations of the status of this species, which is easily disturbed by human visitors.

Acknowledgements

This paper is Contribution 15 of the Antarctic Site Inventory project. We thank Brent Houston and Richard Polatty, who actively collected Inventory census data during the

Table 5. Antarctic Site Inventory censuses for blue-eyed shag (*Phalacrocorax atriceps*), 1994–2000. N1 = nests individually counted, accurate to better than ±5%; N2 = nests counted in known area then extrapolated over total colony area, accurate up to 5–10%; N3 = accurate estimate, accurate to 10–15%; C1 = chicks individually counted, accurate to better than ±5%.

Census		Date	Notes
Hannah Point, Livingston Island (SH) – 62°39'S, 60°37'W			
10	N1	Dec 1994	
7	N1	Nov 1995	
5	N1	Dec 1995	
5	N1	Dec 1996	
7	N1	Dec 1997	
5	N1	Dec 1998	
7	N1	Dec 1999	
5	N1	Jan 2000	
2	C1	Dec 1999	
8	C1	Jan 2000	
9	C1	Jan 2000	
Paulet Island (NE) – 63°35'S, 55°27'W			
432	N1	Nov 1995	
326	N1	Nov 1996	
360	N1	Dec 1996	
377	N2	Nov 1999	
Orne Islands (NW) – 64°40'S, 62°40'W			
15	N1	Dec 1994	Colony located on southwestern end of the site, and exposed to Gerlache Strait
9	N1	Nov 1995	
5	N1	Dec 1996	
3	N1	Dec 1997	
1	N1	Nov 1998	
1	N1	Dec 1998	
0	N1	Dec 1999	One-meter-deep snow on the shag nesting ledges
0	C1	Jan 2000	
Jougla Point/Port Lockroy, Wiencke Island (NW) – 64°49'S, 63°30'W			
31	N1	Dec 1994	Recent historic censuses include: 60 (N3, Jan 1983; reported in Parmelee 1992); 65 (N1, Dec 1983; reported in Parmelee 1992); 40 (N3, Jan 1984; reported in Parmelee 1992); 60 (N3, Jan 1989; reported in Parmelee 1992); and 43 (N1, Dec 1993; S. Drennan, personal communication)
22	N1	Nov 1995	
25	N1	Jan 1996	
20	N1	Nov 1997	
20	N1	Dec 1997	
22	N1	Nov 1998	
25	N1	Dec 1999	
26	N1	Jan 2000	R. Downie, personal communication
58	C1	Jan 1995	
50	C1	Jan 1996	
33	C1	Feb 1998	N. Milius, personal communication
45	C1	Jan 2000	R. Downie, personal communication
43	C1	Jan 2000	
Cliffs near Almirante Brown Station, Paradise Bay (NW) – 64°53'S, 62°52'W			
Colony #1			
72	N1	Jan 1994	
76	N1	Dec 1994	
60	N1	Nov 1995	
57	N1	Dec 1995	
56	N1	Nov 1996	
53	N1	Dec 1996	
46	N1	Nov 1997	
46	N1	Dec 1997	
43	N1	Jan 2000	
81	C1	Jan 2000	

Table 5 continued

Census		Date	Notes
Colony #2			
18	N1	Jan 1994	
24	N1	Dec 1994	
16	N1	Nov 1995	
14	N1	Dec 1995	
10	N1	Nov 1996	
6	N1	Nov 1997	
8	N1	Dec 1997	
6	N1	Jan 2000	
11	C1	Jan 2000	
Colonies #1 and #2			
90	N1	Jan 1994	
100	N1	Dec 1994	
76	N1	Nov 1995	
71	N1	Dec 1995	
66	N1	Nov 1996	
52	N1	Nov 1997	
54	N1	Dec 1997	
49	N1	Jan 2000	
92	C1	Jan 2000	
Petermann Island (SW) – 65°10'S, 64°10'W			
34	N1	Dec 1994	
27	N1	Nov 1995	
33	N1	Dec 1995	
29	N1	Dec 1996	
29	N1	Jan 1997	
29	N1	Nov 1997	
30	N1	Dec 1997	
67	C1	Jan 1995	
50	C1	Jan 1996	
57	C1	Jan 1999	
46	C1	Jan 2000	

Table 6. Antarctic Site Inventory censuses for southern giant petrel (*Macronectes giganteus*), 1994–2000. N1 = nests individually counted, accurate to better than ±5%.

Census		Date
Penguin Island (SH) – 62°06'S, 57°54'W		
507	N1	Dec 1997
578	N1	Dec 1998
439	N1	Jan 1999
634	N1	Dec 1999
Aitcho Islands visitor site (SH) – 62°24'S, 59°44'W		
81	N1	Jan 1999
108	N1	Dec 1999
Hannah Point, Livingston Island (SH) – 62°39'S, 60°37'W		
117	N1	Dec 1997
110	N1	Jan 1999
126	N1	Dec 1999
111	N1	Jan 2000

1994–95 and 1995–96 field seasons, and Boyd D. Pyper, who actively collected inventory census data during the 1999–2000 field season. The authors gratefully acknowledge assistance from the following sources that have supported the Antarctic Site Inventory project: the Tinker Foundation; the Environmental Defense Fund; the US Marine Mammal Commission; the UK Foreign and Commonwealth Office, South Atlantic and Antarctic Department; Captains B. Bryant and T. Barton and the officers and crew of HMS *Endurance*; the US National Science Foundation Office of Polar Programs (Award Nos. NSF/OPP 94-9407212, 96-42732, and 96-43904); the US Environmental Protection Agency; the German Umweltbundesamt (Federal Environmental Agency) on behalf of the German Federal Environment Ministry (assistance registration nos. 201 01 160/4 and 297 19 160/04); the International Association of Antarctic Tour Operators (IAATO); IAATO member companies Abercrombie & Kent (and the officers, crew, and staff of *Explorer*); Society Expeditions (and the officers, crew, and staff of *World Discoverer*); Quark Expeditions (and the officers, crew, and staff of *Alla Tarasova* and *Akademik Vavilov*); Marine Expeditions (and the officers, crew, and staff of *Livonia*); and Mountain Travel Sobek (and the officers, crew, and staff of *Akademik Shuleykin*); and the World Wildlife Fund-US. Special thanks to Robert Rosenfeld, for advice and suggestions regarding the statistical analyses presented in this paper.

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Appendix 8: Peninsula penguin populations

STUDY SUBAREA	ADPE POP (pairs)	%	CHPE POP (pairs)	%	MCPE POP (pairs)	GEPE POP (pairs)	%
SO	218,095	31.5%	595,747	27.2%	23	12,450	15.4%
EI	121	0.0%	448,160	20.5%	7,313	2,600	3.2%
SH	54,042	7.8%	1,069,224	48.8%	144	32,838	40.7%
NE	294,169	42.5%	0	0.0%	0	1,206	1.5%
SW	88,824	12.8%	9	0.0%	0	2,055	2.5%
NW	37,285	5.4%	76,500	3.5%	0	29,496	36.6%
PEN Total	692,536	100.0%	2,189,640	100.0%	7,480	80,645	100.0%
Total Pop	2,465,800		7,490,200		11,841,600	314,000	
PEN %	28.1%		29.2%		0.1%	25.7%	

Source: Woehler, 1993; Woehler & Croxall, 1996

KEY
ADPE = Adélie penguin
CHPE = chinstrap penguin
MCPE = macaroni penguin
GEPE = gentoo penguin
POP (pairs) = minimum number of breeding pairs
SO = South Orkneys
EI = Elephant Island (and nearby islands)
SH = South Shetland Islands
NE = Northeast Antarctic Peninsula, from Cape Dubouzet to James Ross Island
SW = Southwest Antarctic Peninsula, from Lemaire Channel to Marguerite Bay
NW = Northwest Antarctic Peninsula, from Cape Dubouzet to Lemaire Channel

PEN Total = total number of penguins in the ASI study area (the Antarctic Peninsula)
PEN % = percentage of world population found in the ASI study area
Total Pop = minimum number of breeding pairs, world population